REMARKS/ARGUMENTS

In the present Response, Applicant has amended Claims 1 and 12-21; no Claims have been added or withdrawn. Thus, Claims 1-27 are pending in the case.

In the Office Action, the Examiner rejected Claims 12-27 under Section 112 as being indefinite. The Examiner's concern centered around Applicant's use of the terms "spectrometer rotor" and "spectrometer." Applicant disagrees with the Examiner's assessment. Specifically, a "spectrometer" describes an apparatus or means for separating articles. This is well known to those in the art. Many different types of spectrometer exist, for example those adapted to separate radiation of different wavelengths, chemical groups in compounds, or, as in the present application, particles of different charge or mass. A "rotor" is, as its name suggests, merely a rotating part.

As a result, Claims 12-21 are directed to a rotating part of the spectrometer and each recites elements specifically related to that rotating part. Similarly, Claims 22-27 relate to a spectrometer (that is, an apparatus for separating), and recite elements of that apparatus relevant to the present invention. It is therefore believed that the claims are definite.

In the Office Action, the Examiner also rejected Claims 1-27 under Section 103 as being obvious in view of Saito ('849) and Ivory et al. ('258) or Tolley et al. ('369).

Applicant has amended Claims 1 and 12 to bring out more fully the salient features of the invention. In particular, Claim 1 has been amended to incorporate the step (Step c) of applying an electric field which varies with a power of r which is greater than or equal to 1, wherein r is a distance along the channel. Claim 12 has been amended to include field shaping means for shaping an electric field which, in use, varies with a power of r which is greater than or equal to 1, wherein r is a distance along the cavity. As such, the applied electric field varies with a power of r -- which is greater than or equal to 1, wherein r is a distance along the separation channel or cavity. It is submitted that these configurations or steps are neither disclosed in any of the cited art nor obvious from the art.

In particular, Saito discloses a separating apparatus in which an electric field is applied to oppose a centrifugal force. However, as the Examiner has conceded, the electric field applied in Saito is uniform and not like the one in the present application. Both Ivory et al. and Tolley et al. disclose a separation apparatus in which an electric field is applied that varies along the length of the separation channel. However, both Ivory et al. and Tolley et al. are concerned with separation apparatus in which a hydrodynamic force, rather than a centrifugal force, is used in opposition to the electric field to separate particles.

To the extent the Examiner does not fully appreciate the difference between a hydrodynamic force and a centrifugal force, Applicant offers the following explanation. As is well known in the art, a centrifugal force, as employed in the present invention, results when a particle is subject to an angular velocity, ω. The magnitude of the centrifugal force is proportional to the radial distance from the rotation axis, r (see equation 1 on page 8 of the Application). On the other hand, a hydrodynamic force results when a particle is placed in a fluid stream. The magnitude of the hydrodynamic force is not dependent on r. Clearly, hydrodynamic forces and centrifugal forces arise quite differently. As a result, one cannot simply substitute one for the other.

Moreover, the use of hydrodynamic force in spectroscopy has a number of disadvantages. For example, the continuous fluid flow causes constant collisions between the molecules to be separated. This significantly reduces the resolution achievable with the spectrometer. Further, the hydrodynamic force depends on the shape of the molecule as well as its mass and charge. Again, this leads to a wide distribution of particles. In practice, the fluid flow is also affected by the sides of the container in which the particle separation takes place. The fluid can move faster in the center of the channel than at the sides where it is dragged by the walls of the container. This results in the bands of particles being curved which gives a less accurate reading on the spectrometer. None of these problems are encountered with a spectrometer which utilizes centrifugal force. To a person skilled in the art therefore, the fields of hydrodynamic flow spectrometers and centrifugal spectrometers, although related, are quite distinct.

Additionally, it is also evident to a person skilled in the art that an electric field applied to oppose a hydrodynamic force would not produce the desired separation effect if applied in opposition of a centrifugal force.

Attached are Figures A to C to clarify the following explanation - -

In a spectrometer, each particle is subjected to two opposing forces. In the cited documents Ivory et al. and Tolley et al., these forces are a hydrodynamic force which is constant along the separation channel and an electric force which varies along the channel. The particle is at equilibrium when the two forces are equal to one another, and this occurs at a point r_1 along the channel which will depend on the particle's mass, charge and shape amongst other factors. The electric field shape depicted in Figure A is an example of that described in Tolley et al., namely a non-linear, monotone, non-decreasing function with a non-increasing first derivative (page 3 paragraph 35). However, if the hydrodynamic force of Ivory et al. or Tolley et al. were replaced by a centrifugal force, as proposed by the Examiner, the resulting spectrometer would not work. As shown in Figure B, an unstable equilibrium position is established where the electric and centrifugal forces are equal to one another (r_2). Where $r<r_2$, the electric force is greater than the centrifugal force and the particles will be moved towards the rotation axis (to the left on Figure B). Where $r>r_2$, the centrifugal force is greater than the electric force and will tend to move the particle away from the rotation axis. In each case, the particle is moved away from equilibrium position r_2, and thus no clear band is formed.

The present invention achieves a workable arrangement in which a centrifugal force is opposed by an electric force which varies along the separation channel. This is neither suggested nor proposed by any combination of the cited documents. This is realized by applying an electric field which varies with a power of r which is greater than or equal to 1, wherein r is a distance along the channel. This is shown in Figure C on the attached sheet, where it can be seen that a stable equilibrium is established at r_3. It should be noted that the shape of the electric field in the attached diagram is only one example of fields which could achieve a stable equilibrium and fall within in the scope of the proposed amended claim.

These amendments to Claims 1 and 12 add no new matter. They are well supported in the specification, e.g., page 7 at lines 24 to 25 (note that the electric force is proportional to the electric field) and at page 8 lines 9 to 11. None of the cited documents discloses applying a varying electric force to a centrifugal spectrometer. Moreover, none discloses the use of an electric field of the shape described above.

It is therefore submitted it would not be at all obvious to modify the apparatus of Saito so as to achieve the advantages of the present invention, even in view of Ivory et al. or Tolley et al.

Additional changes to the claims have also been made to clean-up the language. Specifically,

In step (c) of Claim 1, the word "creating" has been changed to "applying" (for support, see specification at page 8 line 4).

In Claim 12, the term "blade" has been replaced with "cavity" (for support, see page 4 line 14).

In Claims 13-21, the word "blade" has been replaced with "cavity."

In Claim 17, the claim has been re-written to call for "the spectrometer rotor as claimed in claim 12 in which the cavity is defined within a disc-like rotor body."

The drawings accompanying this Response were published with the corresponding PCT application, WO03/051520 and should therefore overcome the Examiner's objections.

In view of the above, all pending claims are believed to be in condition for allowance; an action to this end is earnestly requested. If it would expedite the progress of this Application through the examination process, the Examiner is authorized to call the undersigned attorney.

A Petition for a One Month Extension of Time within which to submit this Response is included.

The Examiner and Commissioner are hereby authorized to charge any fees or additional fees associated with this Response or refund any overpayments associated with this Response to our deposit account, Deposit Account No. 23-0280.

Respectfully submitted,

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Kathleen Rundquist

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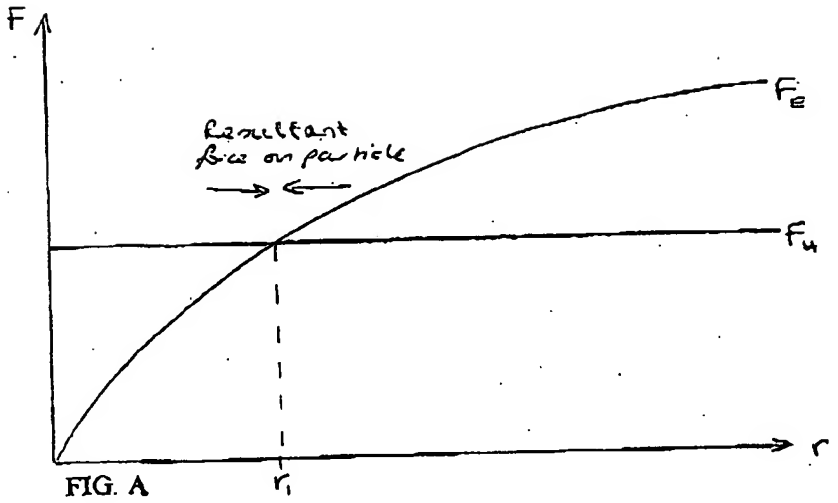

FIG. A

Tolley et al.
Ivory et al

F_H = Hydrodynamic Force

F_E = Electric Force

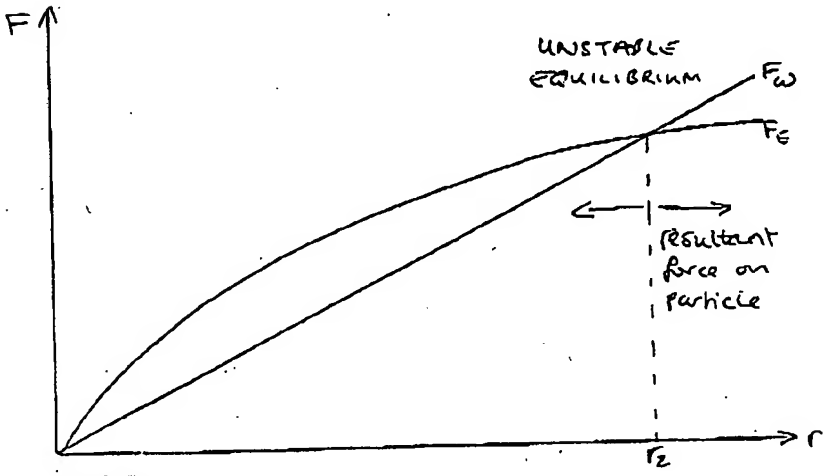

FIG. B

F_W = centrifugal Force

F_E = Electric Force

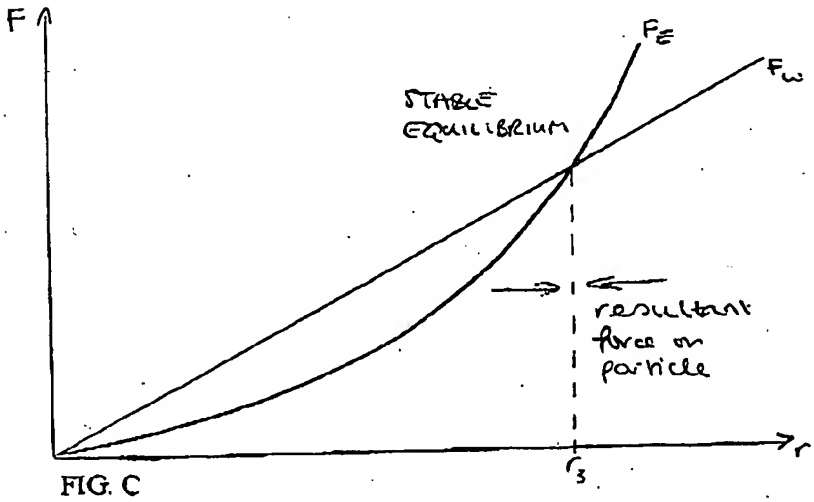

FIG. C

The present invention

F_W = centrifugal Force

F_E = Electric Force